A STUDY ON THE PREVALENCE OF OVERWEIGHT AND HYPERTENSION AND ASSOCIATED RISK FACTORS IN ADOLESCENT SCHOOL CHILDREN 12 – 16 YEARS IN CHENNAI

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CERTIFICATE

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CONTENTS

INTRODUCTION

The importance of identifying children who are at risk of developing the metabolic syndrome cannot be underestimated. The syndrome is a cluster of risk factors for cardiovascular disease and type 2 diabetes, including abdominal obesity, dyslipidemia,glucose intolerance and hypertension. The modern obesogenic environment is one of a number of factors that are driving an increase in these risk factors in children and adolescents.

Obesity is associated with an increase in risk factors for cardiovascular disease. The persistence of these from childhood and adolescence to adulthood has been shown in a number of studies.

A clinically accessible diagnostic tool which avoids measurements that are likely onely available in research settings is needed to identify the metabolic syndrome in children and adolescents worldwide. This is the reason for the incorporation of waist circumference percentile in the IDF consensus definition for metabolic syndrome in children and adolescents in 2007.

The 1997 expert panel of The Maternal and Child Health Bureau, Health resources and Services Administration, The Department of Health

and Human Services recommended that BMI be routinely used to screen children for overweight. This will identify children at risk for developing adverse cardiac events and the metabolic syndrome later in life. Early recognition is desirable because early intervention in the form of lifestyle modification will go a long way in favorably affecting those children at risk.

Also, the incidence of primary or essential hypertension is on the rise in our children and adolescent population as shown by various studies. Hypertension (BP>95th percentile) is also included as a criterion for the diagnosis of the metabolic syndrome in children and adolescents in the IDF (International Diabetes Federation) consensus definition published in 2007.

This study primarily aims to find out the prevalence of overweight and hypertension and the associated risk factors in adolescent school children in Chennai aged 12 – 16 years.

REVIEW OF LITERATURE

The IDF definition of the at risk group and the metabolic syndrome in children and adolescents.

Age group (Yrs)	Obesity (WC)	Triglycerides	HDL-C	Blood Pressure	Glucose (mmol/L) Known Type 2 DM
6 to <10	>90th percentile	Metabolic syndrome cannot be diagnosed but further measurements should be made if there is a family history of metabolic syndrome, T2DM, dyslipidemia, hypertension, cardiovascular disease and/ obesity			
10 to <16	>90th percentile or adult cutoff if lower	>1.7 mmol/L (150 mg/dL)	<1.03mmol/L) (<40 mg/dL)	Systolic >130 mm Hg Diastolic >85 mm Hg	>5.6 mmol/L (100 mg/dL)
16 and above	Use existing IDF criteria for adults				

The centre for disease control, Atlanta has defined 'at risk of overweight' as a BMI > 85th to 94th percentile and 'overweight' as a BMI of >95th percentile. Most children experience obesity than any of the other metabolic syndrome risk factors. Therefore, obesity and insulin resistance have greater impacts on the risk of developing the syndrome than the other factors. Obesity can be viewed as a root disease, as health problems presently associated with pediatric obesity were essentially non existent 15 – 20 yrs ago. According to Ribeiro et al.,(2004), about 62% of boys and girls at risk for obesity are likely to experience other metabolic syndrome risk factors. Obesity has been shown to increase the likelihood

of developing the metabolic syndrome in children 8 – 10 times (Harrell et al., 2006).

Prevention and treatment of the metabolic syndrome

The metabolic syndrome is due partially to health practices, therefore healthy lifestyle choices can aid in prevention and treatment. These include education, physical activity participation, physical fitness , healthy diets and regular health check ups. The focus should be on prevention, as all of these risk factors are controllable.

Education

The environmental culture that children grow and develop in is essentially determined by parents. Parents must understand the detrimental effects that poor eating habits, a sedentary orientation and low fitness have on the metabolic syndrome. For parents to provide children with a healthy living environment, they must practice healthy living themselves this should include regular health check ups , and showing the child how to live.

Cook S et al estimated the prevalence of metabolic syndrome in adolescents 12 – 19 yrs by applying a modification of the ATP III definition for adults. The prevalence was found to be 4.2% overall (6.1 %

of males and 2.1 % of females). Of adolescents with the syndrome, 73.9% were overweight and 25.2% were at risk of overweight.

De Ferranti et al examined more than 3400 children and one in ten had the metabolic syndrome.

Using a sample of adolescents from NHANES III, the overall prevalence of the metabolic syndrome in moderately obese subjects was found to be 38.7% and 49.7% in severely obese subjects by Weiss et al.

Age adjusted prevalence of overweight from national surveys(1963 to 1994) 12 – 17 yrs

Population group	***Males***	***Females***
ALL races		
NHES II	3.9	4.3
NHANES I	3.8	3.6
NHANES II	6.5	5.5
NHANESIII	11.4	9.9

HYPERTENSION

Definition of blood pressure

Blood pressure is the lateral pressure exerted by the blood on the vessel walls while flowing through it.

Lateral pressure is that pressure when force is exerted at right angles to the direction of flow at any point within a tube filled with a circulating fluid. Resistance is opposite to force.

Systolic pressure	:	The maximum pressure during systole.
Diastolic pressure	:	The minimum pressure during diastole.
Pulse pressure	:	The difference between systolic and accepted diastolic pressure
Mean pressure	:	Diastolic pressure plus one third of pulse pressure

PHYSIOLOGY

Physiological variations of blood pressure

A. AGE

Blood pressure rises with age.During infancy the systolic pressure is from 70 – 90 mm Hg. In children it is 90 – 110 mmHg and at puberty 110- 120 mm Hg.

B. SEX

In females both systolic and diastolic pressures are slightly lower than in males upto the age of 40 – 50 years.

C. BUILD

The systolic pressure is usually high in obese persons

D. EXERCISE

In strenuous exercise the systolic pressure increases and may reach even upto 180 mm Hg and in moderate exercise there is a slight increase in systolic pressure.

E. POSTURE

The diastolic pressure is slightly higher in the standing position. In the recumbent posture the diastolic pressure is lower than in standing or sitting posture.

F. SLEEP

Systolic pressure falls by about 15 – 20 mmHg during sleep.

G. AFTER INGESTION OF FOOD

There is a slight increase of systolic pressure

H. EMOTION OR EXCITEMENT

Causes increase in systolic pressure

FACTORS CONTROLLING ARTERIAL BLOOD PRESSURE

1. Pumping action of the heart
2. Cardiac output
3. Peripheral vascular resistance: It is the resistance which the blood has to overcome while passing through the periphery. The chief seat of arterial resistance is the arterioles. It depends upon the following
    a. Velocity of blood
    b. Elasticity of arterial walls
    c. Lumen of blood vessels
4. Elasticity of arterial walls
5. Blood volume
6. Viscosity of blood

SIGNIFICANCE OF BLOOD PRESSURE

The height of systolic pressure indicates:

1. The extent of work done by the heart
2. The force of pumping
3. The degree of pressure the arterial walls have to withstand.

Diastolic pressure indicates the measure of peripheral vascular resistance against which the heart has to work constantly.

The normal function of blood pressure is

1. To maintain sufficient pressure head to keep the blood flowing.
2. To provide for the motive force of filtration at the capillary bed thus providing nutrition to the tissue, formation of lymph and so on.

MEASUREMENT OF BLOOD PRESSURE

GENERAL PRECAUTIONS

Errors in measurement revolve around the patient, the instrument, the technique of measurement and the examiner.

THE PATIENT

The level of arterial blood pressure both systolic and diastolic may vary considerably with the phase of respiration or with the changes in cardiovascular hemodynamics. Deep breathing, crying, laughing, anxiety, recent activity and abnormal body temp may exert profound influences. Thus it is important to reassure the patient and to allow time for recovery from apprehension or recent activity. Since the state of relaxation is generally less stable in children than in adults, greater difference with consecutive measurements are often observed particularly with age group under 2 to 4 yrs.

THE CHOICE OF INSTRUMENT

The mercury manometer is the sphygmomanometer of choice as it has the advantages of widespread general usage, reliability, accuracy and of not requiring recalibration. The level of mercury at zero cuff pressure and definition of the meniscus should be checked before measurement. Aneroid manometers are inferior to the mercury type since the former are more sensitive to jolt and mechanical error.

TECHNIQUE OF MEASUREMENT

The mercury column must be vertical and the eyes of the examiner should be at the level of meniscus . The appropriate sized cuff should be used.

The preparation of the child is essential for the determination of BP. The examining room should be quiet. The procedure is fully explained to the children and they are allowed to sit for 15 minutes to recover from recent activity and apprehension. The children were examined in a comfortable sitting position with right arm fully exposed, resting on a supportive surface at the heart level. The manometer should be placed at the observer eye level.

THE WIDTH OF THE CUFF

The Riva Rocci's cuff which is too narrow may result in an error on the higher side whereas one which is too wide may result in an error on the lower side. Use of a narrow cuff requires higher inflation pressures to compress the artery while the use of a cuff which is too wide compresses a large segment of the vessel, resulting in increased resistance to flow and a tendency for pulse to disappear before it reaches the lower edge of the cuff.

Although Moss et al., established a relatively precise index for proper cuff selection for a given child, for practical purposes it is significant merely to select a cuff which covers about two thirds of the arm length.

DIMENSIONS FOR APPROPRIATE SIZE CUFF

Range of dimension of the bladder (in cm)

Cuff name	Width (cm)	Length (cm)
Newborn	2.5- 4	5 – 10
Infant	6 - 8	12 -1 3
Child	9 - 10	17 – 22.5
Adult	12 - 13	22 – 23.5
Large adult arm	15.5	30
Adult thigh	18	36

LENGTH OF THE CUFF

Ideal cuff should have a bladder length that is 80% and a width that is at least 40% of the arm circumference.(Length to width ratio of 2:1 Pickering et al).

Data regarding the appropriate size cuff for measurement of blood pressure in the lower extremity is lacking. The common impression that arterial pressure is higher in the leg than in the arm is a misconception and probably reflects the use of cuffs with inadequate width.

The cuff should be applied snugly to the bare limb. A loosely applied cuff results in ballooning of the bag and narrowing of the effective surface.

THE EXAMINER

Determination of the blood pressure can be entrusted to physician's ability to hear the Korotkoff sounds and relate them to calibrated mercury column. It is recommended that the average of atleast three readings of systolic and diastolic pressures be accepted as the final estimate.

METHODS OF BLOOD PRESSURE MEASUREMENT

AUSCULTATORY METHOD

The diaphragm of the stethoscope is firmly applied over the cubital fossa. It should not be in contact with the lower edge of the cuff. The cuff should be inflated rapidly by about 30 mm of mercury above the systolic BP detected by palpatory method and the cuff be deflated at 2 mm Hg per second. Too rapid deflation rate can result in error in either direction. Low value obtained when the rate is so fast that the various phases of vascular sounds cannot be accurately interpreted. High values are obtained if the rapid rate of deflation creates a negative pressure above the mercury column and prevents the equalization of the pressure in the cuff and the manometer. Inflation must be rapid since slow inflation may

result I a period between systolic and diastolic pressure during which all vascular sounds disappear (auscultatory gap). The auscultatory gap may result in profound error in interpretation of either systolic or diastolic pressure.

With cuff inflation above the peak pressure of the arterial pulse wave, the artery is completely occluded. With gradual deflation , the vessel opens and the pressure pulse is transmitted to the periphery and the vascular sounds of Korotkoff become audible. These can be identified as occurring in 5 distinct phases

Phase 1 : A sudden appearance of a sharp thud

Phase 2 : Prolongation of sound into a murmur

Phase 3 : Increased intensity of sound

Phase 4 : Muffling of sounds

Phase 5 : Complete disappearance of sounds

There is a universal agreement that phase 1 is the index of systolic BP. The index of diastolic BP is less certain and rests between muffling and cessation of the sounds.

Available data indicate that in children, muffling is probably the best index but neither muffling nor cessation accurately reflect intra arterial pressure.

Muffling tends to give higher readings and cessation gives lower reading. Latest recommendations of the American Heart Association regards muffling as the best index of diastolic BP.

Some attention should be directed to the measurement of BP in school going children. It is particularly here that proper selection of cuff size is crucial.It is important to recognize that although some of the cuff pressure may be dissipated by excessive fatty tissue. In view of higher incidence of hypertension in these subjects, it would be a mistake to dismiss on abnormally high readings on the basis of error due to cuff size.

OTHER METHODS OF INDIRECT MEASUREMENT

In infants , measurement of BP by auscultation is often difficult or impossible and other methods must be used. A wide variety of mechanical and electronic devices have been used nowadays but all are based on the traditional methods of palpation, auscultation or oscillometry. Infant should be quiet and immobile since movement or crying will profoundly affect the reading obtained.

ULTRASOUND

Ware et al., described the indirect measurement of systolic pressure utilizing the Doppler principle. This method has been proved quite reliable and a number of devices are commercially available . Antonio Hernandez et al.

FLUSH METHOD

In 1952, Cappe et al., and Goldring et al measured the digital BP by application of a pneumatic cuff to the wrist.

With the infant in a recumbent position, the arm and ankle cuffs are applied. The extremity distal to the cuff is compressed by firmly wrapping it with a soft wide rubber drain, an elastic bandage the purpose of which is to drain the hand or foot of the blood. The wrapping should begin at the tips of the digits working proximally to the lower edge of the cuff. Compression with one hand is to be condemned since it often produces inaccurate results because of incomplete drainage leading to poor definition of the end point. A 5 cm cuff is generally easier to work with but it has been established that various cuffs from 5 – 9.5 cm in width does not significantly affect the reading.

Following completion of the compression, the cuff is inflated to 200 mm Hg and the wrapping removed with slow release of cuff

pressure, a level is eventually reached at which there is a definite flushing of the blanched distal portion of the extremity. This is the end point with a deflation rate not exceeding 5 mmHg /second. The end point has been found to approximate the mean arterial pressure.

Viring et al., recognized that severe anemia, edema and marker hypothermia may adversely affect the end point. Although there are conflicting opinions, it appears that the flush BP is greater in the wrist than ankle during the first yr of life.

PALPATORY METHOD

This is the oldest one, seldom used alone. The radial pulse is located and the pressure in the pneumatic cuff is raised above the level at which palpable pulsation disappears. With gradual deflation of the cuff, the pulsation reappears . The first palpable sound is considered as the systolic BP. This is usually 5 – 10 mm lower than auscultatory method.

VISUAL OSCILLOMETRY

This method was first introduced in 1904 and is based on visualization of the oscillations transmitted by the arterial pulse to the mercury column in the manometer. With cuff deflation, the level at which the oscillation appears and disappears is read as the systolic and diastolic BP respectively. Nowadays this method is not in use.

AIM OF THE STUDY

1. To assess the prevalence of

   - at risk of overweight
   - overweight and
   - asymptomatic hypertension

   in adolescent boys and girls 12 – 16 yrs of age

2. To assess the association of risk factors like

   - Sex
   - Socioeconomic status
   - Family H/O obesity
   - Family H/O HT/DM and
   - Hours of physical activity

   on overweight in these children

SUBJECTS AND METHODS

STUDY DESIGN	:	Cross sectional survey/Case control study
PLACE OF STUDY	:	Middle schools ,high schools and higher secondary schools that belong to The Corporation of Chennai and private schools of Chennai.
DURATION	:	February 2007 – April 2008
INCLUSION CRITERIA:		Healthy boys and girls 12 – 16 years

EXCLUSION CRITERIA

Obesity due to endocrine abnormalities

Syndrome associations

Secondary hypertension

Cardiac / Renal disease

Chronic drug intake

SAMPLE SIZE:

For an existing prevalence of 10%, with 20% precision accuracy and 95% confidence interval , sample size calculated by formula is 1060

n = 1060

CASES: Children "at risk of overweight" and "overweight"

BMI 85th to 94th percentile - "at risk of overweight"

BMI >95th percentile - "overweight"

All children above 85th percentile were arbitrarily taken as overweight for this study purpose.

Blood pressure > 95th percentile - "hypertension"

CONTROLS : Normal children

RISK FACTORS:

1. SEX

2. SOCIOECONOMIC STATUS

The modified Kuppusamy Scale (1997-1998) was used which takes into consideration education and occupation of the parent and the monthly per capita income. Children with a score of fifteen and above were arbitrarily assigned to the high socioeconomic status and those with score <15 were put in the low socioeconomic group

3. FAMILY H/O HT/DM

4. FAMILY H/O OBESITY

5. PHYSICAL ACTIVITY

Arbitarily those children with a physical activity of < 30 minutes for 4 days/week were taken to be at a higher risk.

METHODOLOGY:

The subjects of the study were adolescent school children between the ages of 12 – 16 years of both sexes and belonging to high and low socioeconomic classes as per the modified Kuppusamy's scale.

Age was taken in completed years from the school records.

Height was taken using a vertical scale to the nearest 0.5 cm.

Weight was measured using a standard weighing scale to the nearest 0.5 kg.

The procedure was informed to all children and measures had been taken to reduce their anxiety. Their cooperation was sought specifically for information regarding their father's education, occupation ,monthly income, no of family members, family H/O obesity, HT/DM, hours of physical activity, details of any previous illness or chronic drug intake.

RECORDING OF BLOOD PRESSURE

A cordial atmosphere was created to do an unhurried and relaxed examination. A cursory physical examination was done to rule out endocrine, cardiac and renal problems. BP recording was done as the last part of the examination to allay the anxiety of the child. Prior to recording the child was asked to void urine and basal pressures were obtained. The basal pressure in adolescents seems to be a better predictor of essential hypertension in adulthood than casual blood pressure.

The instrument used was mercury sphygmomanometer in conjunction with a good stethoscope for all ages. Cuff sizes of 7 cm and 12 cm were used and care was taken to select an appropriate sized cuff which covered two third of the arm. All observations were made in the right arm with the child properly seated and the sphygmomanometer at the child's heart level. The cuff was firmly placed over the brachial artery and inflated to 30 mm Hg above the systolic BP calculated by the palpatory method. Then the cuff was deflated by 2 – 4 mm per second. The appearance of the first Korotkoff sound and muffling were taken as corresponding to systolic and diastolic blood pressures respectively. Three readings taken at an interval of 5 minutes each and average of the three readings was taken as the blood pressure.

STATISTICAL ANALYSIS

To examine the various determinants of overweight & obesity like sex, socioeconomic status, family H/O obesity, family H/O HT & DM and physical activity, univariate and multivariate analysis (logistic regression) were performed.

The unadjusted & adjusted odds ratio were computed for overweight with other risk factors collected in the study.

All analysis were two tailed and a p value of <0.05 was considered statistically significant. Statistical analysis was performed using SPSS version 10.0 package.

OBSERVATIONS

TABLE 1

SEX DISTRIBUTION

Sex	No of children	Percentage
Male	510	48%
Female	550	52%
Total	1060	100%

FIGURE 1

SEX DISTRIBUTION

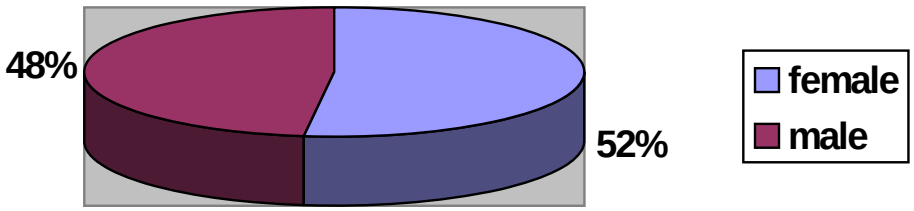

TABLE 2

AGE & SEX DISTRIBUTION

Age	Male	Female	Total	Percentage
12	48	67	115	10.8%
13	67	123	190	17.9%
14	128	156	284	26.8%
15	164	149	313	29.6%
16	103	55	158	14.9%
Total	510	550	1060	100%

Highest number of cases studied was in the age group 15 yrs. In the other groups an average of 150 cases were studied.

TABLE 3

MEAN AND PERCENTILE POSITION FOR SYSTOLIC BP BASED ON AGE AND SEX

Age (yrs)	MALE				**FEMALE**			
	n	**Mean ± SD**	**5th**	**95th**	**n**	**Mean ± SD**	**5th**	**95th**
12	48	112.58 ± 9.91	97.8	125.2	67	107.61±10.45	94.0	120.8
13	67	113.58 ± 9.73	100	126.4	123	109.06±11.11	92.4	124.0
14	128	113.48 ± 9.78	97.8	128.2	156	112.29±11.38	94.0	124.6
15	164	114.04±11.38	96.0	129.0	149	111.91±11.99	90	128.0
16	103	115.17±11.64	96	130.0	55	114.07±12.52	90	129.0

TABLE 4

MEAN AND PERCENTILE POSITION FOR DIASTOLIC BP BASED ON AGE AND SEX

Age (yrs)	**MALE**				**FEMALE**			
	n	**Mean ±SD**	**5th**	**95th**	**n**	**Mean ±SD**	**5th**	**95th**
12	48	74.25±5.11	67	78.2	67	69.85±8.64	64.0	76.2
13	67	73.46±6.44	68.2	79.6	123	72.23±7.76	66.0	78.4
14	128	74.84±5.72	70.6	80.4	156	73.96±7.33	64.3	79.6
15	164	74.49±6.14	71.2	81.3	149	74.03±7.49	65.6	80.0
16	103	75.05±6.16	72.6	83.8	55	76.51±6.31	70.2	82.8

TABLE 5

TYPE OF HYPERTENSION IN VARIOUS AGE GROUPS

	12 yrs		**13 yrs**		**14 yrs**		**15 yrs**		**16 yrs**	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Normal BP	40	51	60	104	112	127	139	124	88	50
Systolic HT	6	3	5	5	8	10	11	8	6	2
Diastolic HT	0	1	0	0	1	0	0	2	0	0
Both	0	2	1	5	2	3	5	3	2	1
Low BP	2	10	1	9	5	16	9	12	7	2
Chisquare value	7.735 NS		4.782 NS		5.418 NS		3.547 NS		1.094 NS	

FIGURE 2

TYPE OF HYPERTENSION IN VARIOUS AGE GROUPS

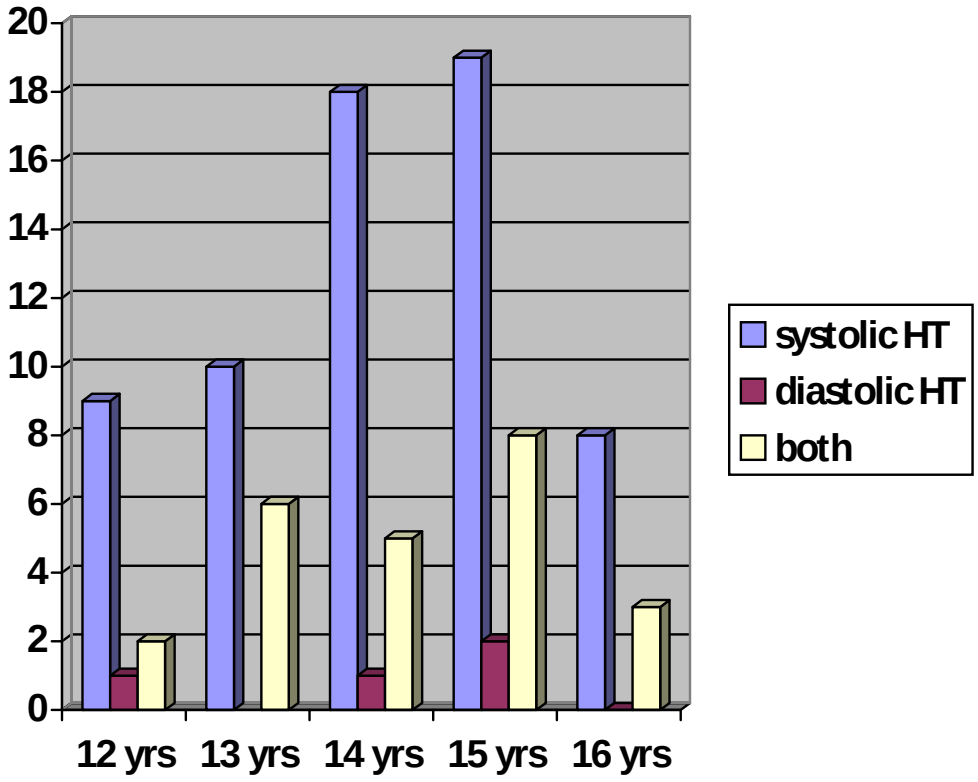

TABLE 6

AGE RELATED HYPERTENSION

Age	Male			Female		
	Total	HT	%	Total	HT	%
12	48	6	12.5%	67	6	8.95%
13	67	6	8.95%	123	10	8.13%
14	128	11	8.59%	156	13	8.33%
15	164	16	9.75%	149	13	8.72%
16	103	8	7.76%	55	3	5.45%

FIGURE 3

PREVALENCE OF HYPERTENSION IN VARIOUS AGE GROUPS

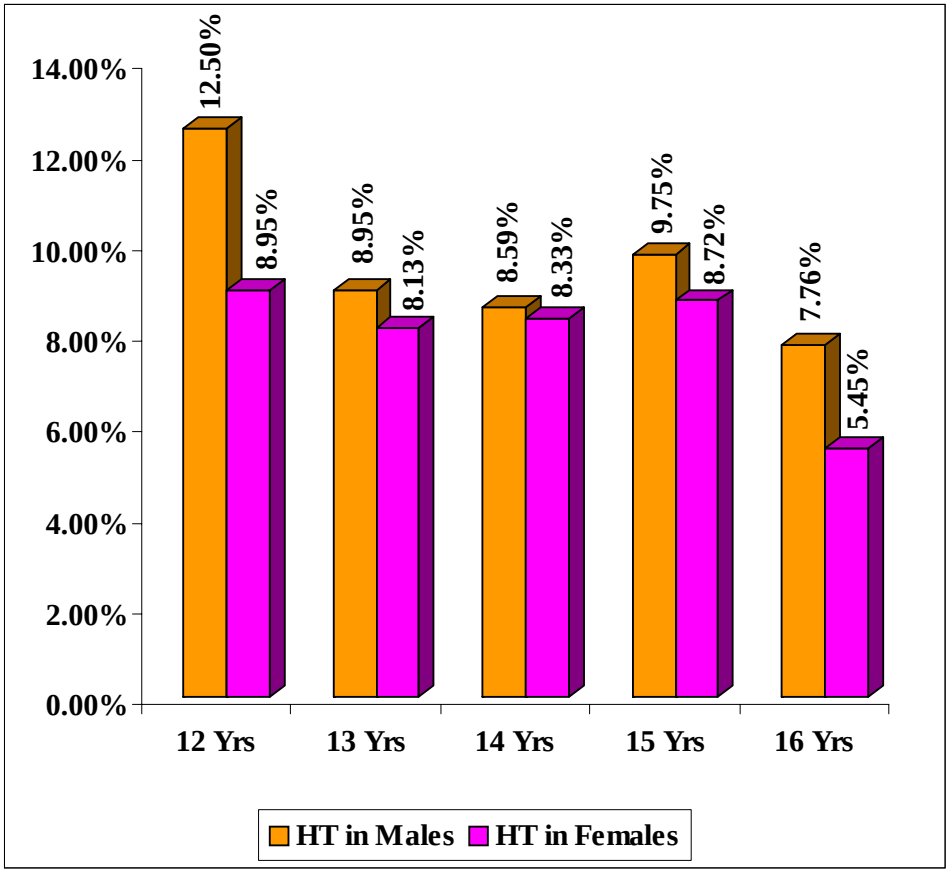

TABLE 7

PREVALENCE OF HYPERTENSION

Number of children studied	Number of children with hypertension	Percentage
1060	92	8.67%

FIGURE 4

PREVALENCE OF HYPERTENSION

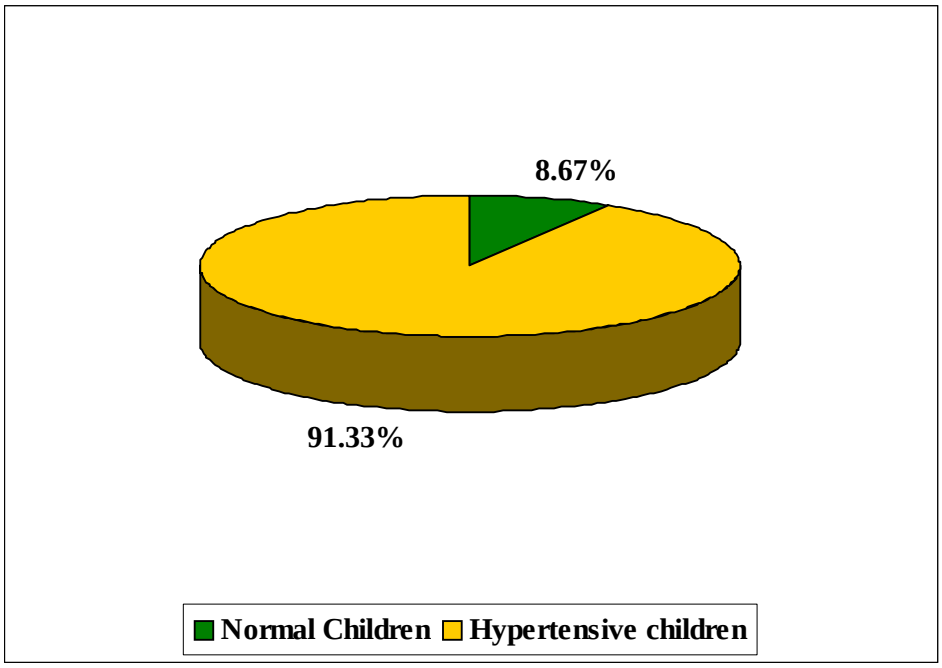

TABLE 8

PREVALENCE OF OVERWEIGHT AMONG MALES

Age	Total population	Overweight (BMI>85th percentile)	Percentage
12	48	4	8.4%
13	67	7	10%
14	128	13	9.9%
15	164	12	7.6%
16	103	9	8.9%
Total	**510**	**45**	**8.82%**

FIGURE 5

PREVALENCE OF OVER WEIGHT AMONG MALES

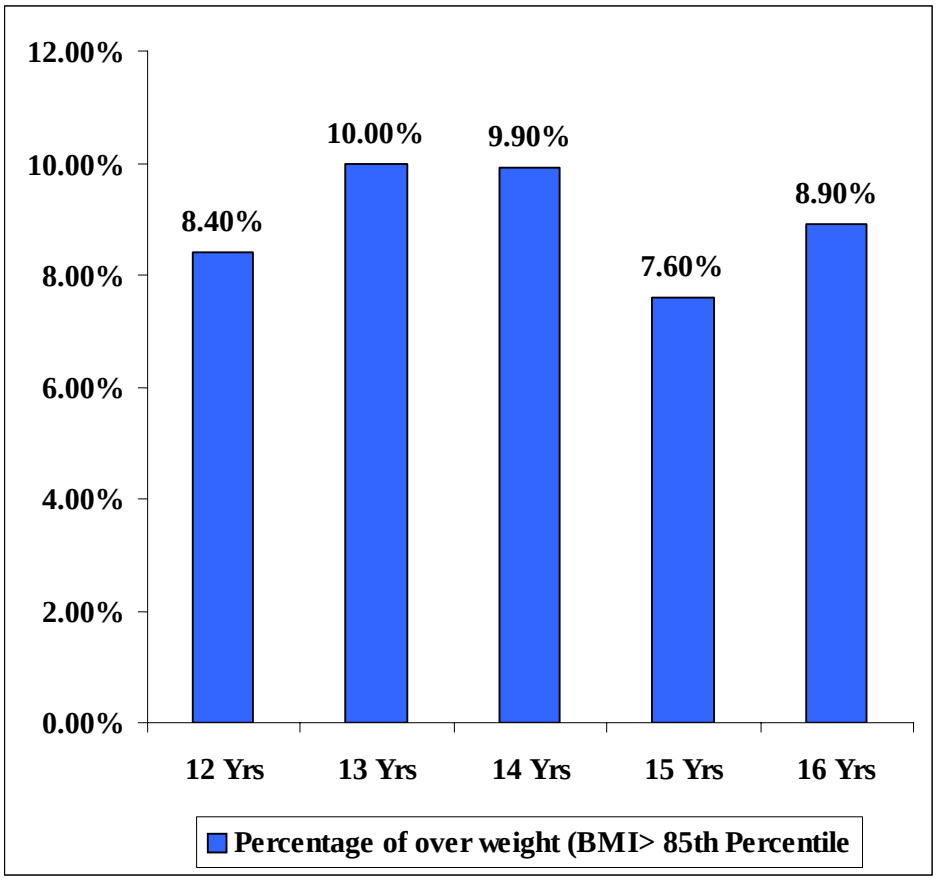

TABLE 9

PREVALENCE OF OVERWEIGHT AMONG FEMALES

Age	Total population	Overweight (BMI>85th percentile)	Percentage
12	67	8	11.9%
13	123	16	13.4%
14	156	19	12.08%
15	149	16	10.57%
16	55	7	13.07%
Total	**550**	**66**	**12%**

FIGURE 6

PREVALENCE OF OVER WEIGHT AMONG FEMALES

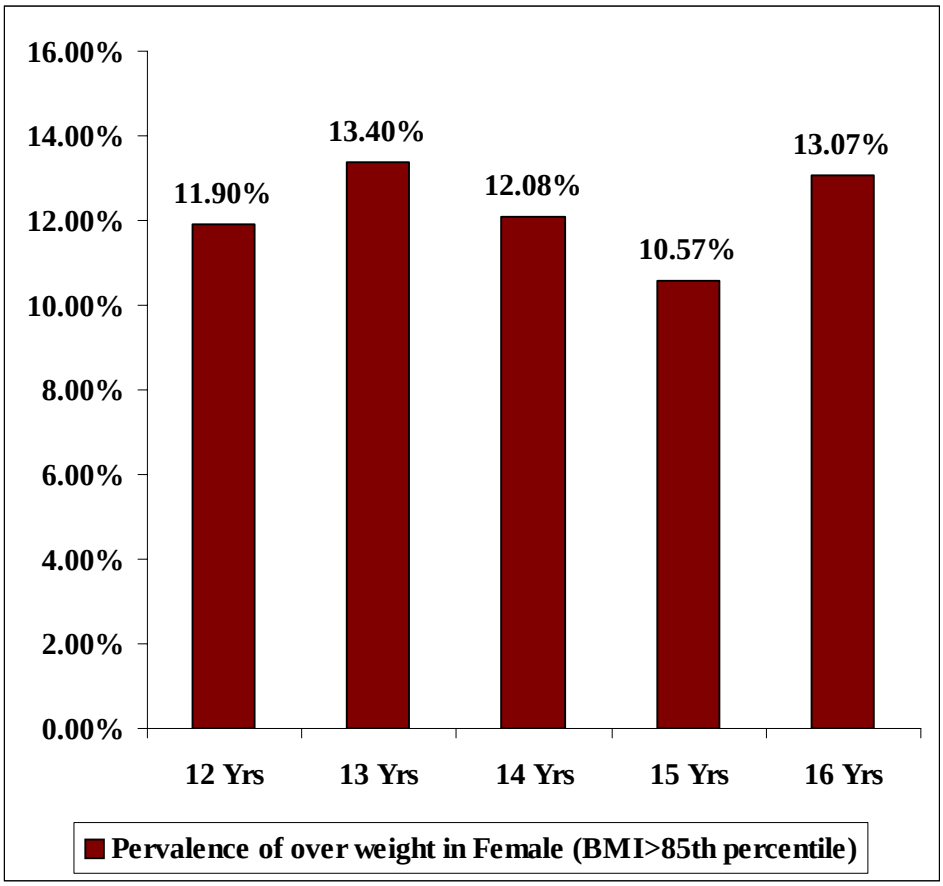

FIGURE 3

PREVALENCE OF OVERWEIGHT AMONG BOYS

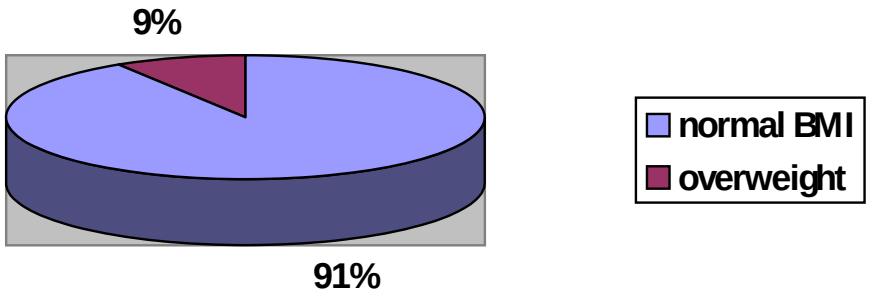

FIGURE 4

PREVALENCE OF OVERWEIGHT AMONG FEMALES

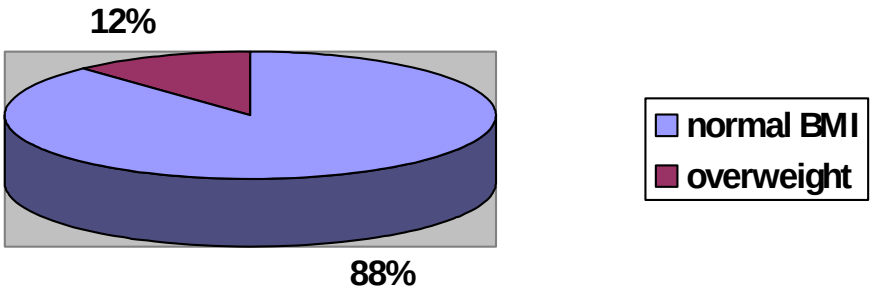

TABLE 10

RISK FACTORS FOR OVERWEIGHT AMONG 12 – 16 YR OLDS – A UNIVARIATE ANALYSIS

S No	Risk factor		Cases		Control		OR (95% CI)	p value
			n	%	n	%		
1.	Sex	Female	66	12%	484	88%	1.388 (1.115 - 1.727)	0.004
		Male	45	8.82 %	465	91.18 %		
2.	Socioeconomic status	High	102	17.1 %	499	82.9%	2.062 (1.409 - 3.017)	0.000
		Low	42	9.1%	417	90.7%		
3.	Family H/O HT/DM	Yes	13	14.2 %	81	85.8%	1.665 (1.205 - 2.301)	0.000
		No	87	9.0%	879	91%		
4.	Family H/O obesity	Yes	37	29.2 %	89	80.8%	4.206 (2.728 - 6.486)	0.000
		No	83	8.9%	851	91.1%		

5.	Physical activity	<30 min	31	9.8%	289	90.2%	0.959 (0.761 - 1.209)	0.770
		>30 min	69	9.4%	671	90.6%		

TABLE 11

RISK FACTORS FOR OVERWEIGHT IN CHILDREN 12 – 16 YRS – A MULTIVARIATE ANALYSIS

Risk factor	SE	df	Significance	OR	95% CI	
					Lower	Upper
Family H/O HT/DM	0.170	1	0.002	1.677	1.203	2.339
Family H/O obesity	0.225	1	0.000	4.679	3.089	7.276
High socioeconomic status	0.119	1	0.000	2.179	1.475	3.220
Female sex	0.115	1	0.057	1.246	0.994	1.562

DISCUSSION

A total of 1060 cases in age groups 12 – 16 yrs of age was tabulated. The highest no of case were studied in the age group of 15 yrs. And lowest number in the age group of 12 yrs.

The mean systolic & diastolic BP levels of the 1060 children were studied in relation to age in both sexes. BP levels were found to increase progressively with age.

The gradual increase in mean systolic & diastolic BP of boys & girls with age as noted by us agrees with the findings of The Task Force Committee Report and other workers. Dubest Londe et al.,

The mean systolic pressure of males for various age groups are higher than females. The difference in diastolic pressure between males and females is negligible.

In Indian school children an increase in systolic BP & diastolic BP with age has also been reported by various authors – Chahar et al., Verma et al., Anand & Tandon, Chadha et al.,

In the present study , the value of systolic & diastolic BP is slightly lower among girls than boys but the difference was not found to be statistically significant in most of the age groups. This is consistent with the finding of Laroia et al., Voors et al, Anand & Tandon et al., Chadha et al.

The prevalence of HT in school children of Chennai is 9.21% in boys & 8.18% in girls in our study. According to Chadha et al., the prevalence of HT in Delhi school children of age 5 – 14 yrs is 11.7%. Anjana,Prabhjot et al., reported a prevalence of 7.5% in boys & 6.52% in girls in Amritsar. But Chahar et al .,Agarwal et al & Anand & Tandon reported a low prevalence of hypertension i.e. o.41 – 3.5% among school children. The reason for low prevalence of hypertension in this population according to Chadha is mainly due to the use of arbitrary criterion of HT assessment & not the recognized criterion of 95^{th} percentile for age & sex.

In the present sample , sex difference in the prevalence of HT was not statistically significant (p value> o.o5). the finding that there are no appreciable sex difference in the prevalence of Ht among school children has also been observed by Chadha,Anand & Tandon, Voors et al.,

In our study, the prevalence of overweight is 10.47%(111/1060). Overweight among males was 8.82% (45/510) and among females was 12% (66/550).

Prevalence of overweight among low socioeconomic status was 9.1% compared to 17.1% among high socioeconomic status in our study.

Family H/O HT/DM among overweight children was 13% compared to 8.4% in others.

Overweight children were 4 times more likely to have a family H/O of obesity compared to children with normal BMI [OR(95% CI) 4.20(2.728- 6.486)].

Overweight children were 1.3 times more likely to be females when compared to children with normal BMI [OR (95% CI) 1.388 (1.115- 1.727)].

Physical activity was not found to be a significant risk factor by univariate analysis by our study.

The factors which wre found to be significant by univariate analysis namely family H/O HT/DM, family H/O obesity, high socioeconomic status and female sex were included for multivariate analysis.

Three risk factors namely

Family H/O HT/DM [OR (95% CI) 1.677 (1.203 – 2.339)] &

Family H/O obesity [OR (95%CI) 4.679(3.009- 7.276)] &

High socioeconomic status [OR (95% CI) 2.179 (1.475 – 3.220)] were found to be independent risk factors for overweight by multivariate analysis in the study.

SUMMARY

- The prevalence of HT (BP> 95th percentile) in adolescent children 12 – 16 yrs was found to be 9.21 % in boys and 8.18% in girls.

- BP levels were found to increase progressively with age.

- "At risk for overweight" and "overweight" (BMI >85th percentile) had an overall prevalence of 10.47% (8.82% in males and 12% in females.

- High socio economic status, family H/o obesity and family H/O HT/DM were found to be independent risk factors for overweight in the children studied.

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